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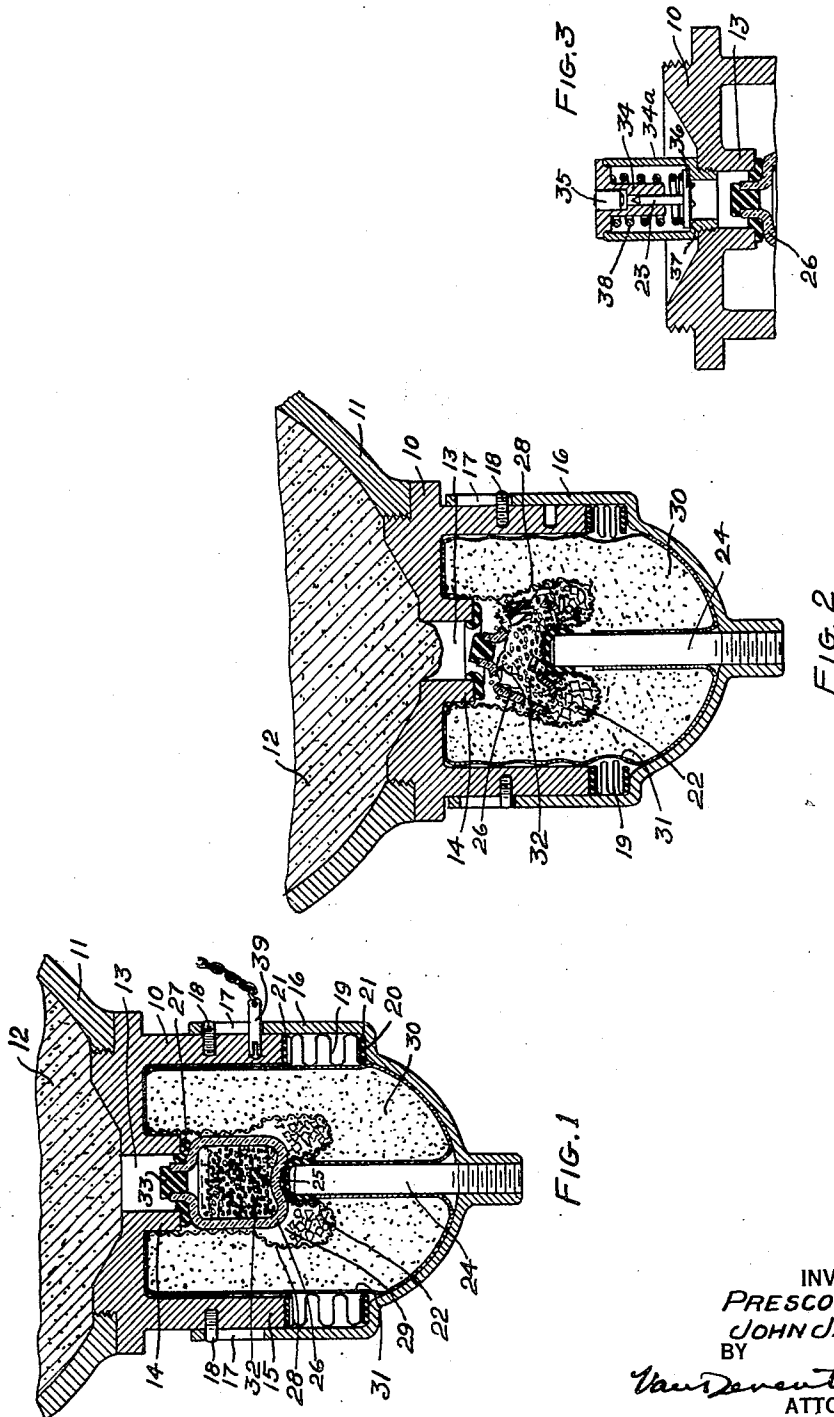
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EXPLOSIVE AND DETONATING APPARATUS

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2 Sheets-Sheet 1



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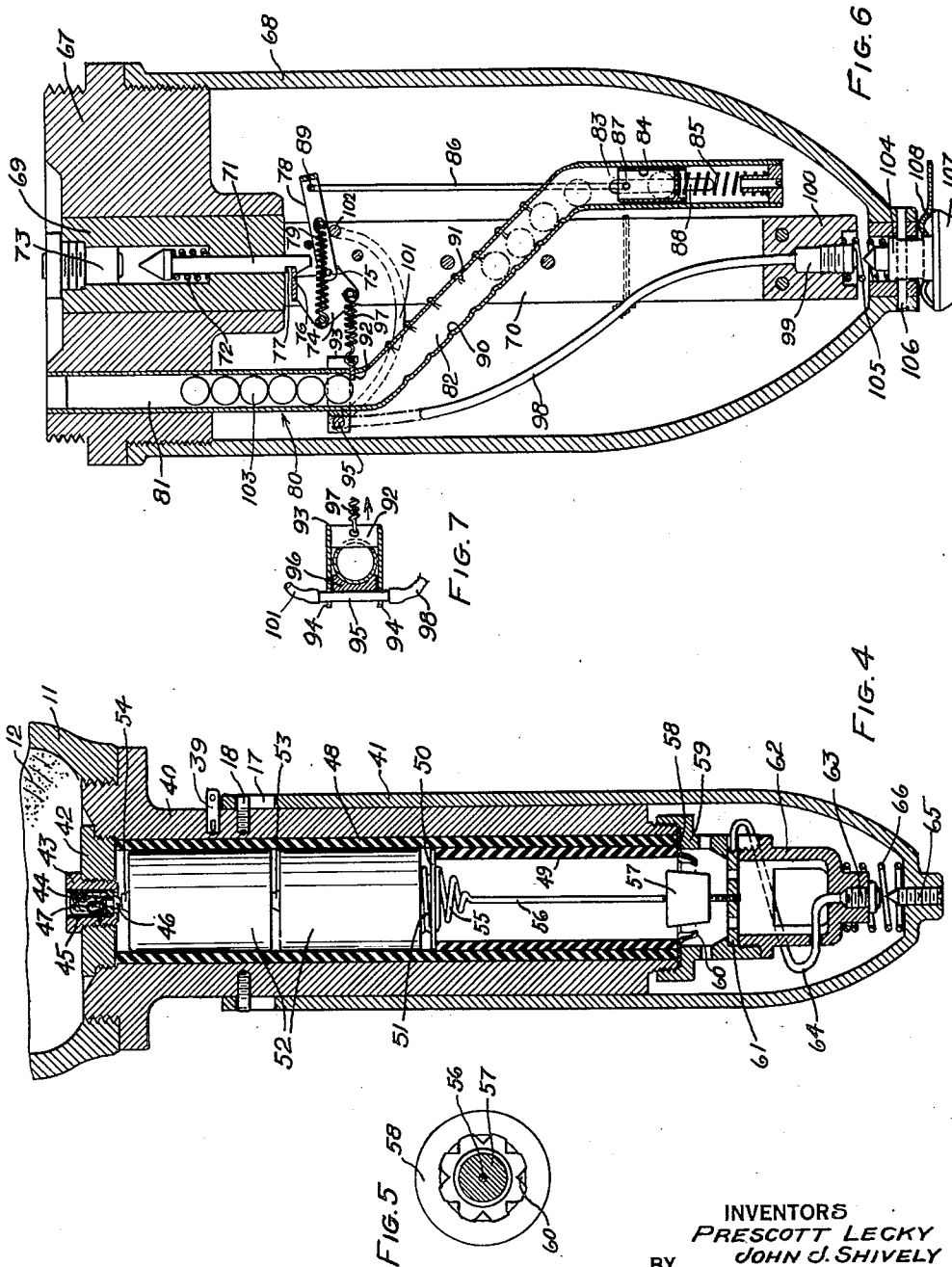
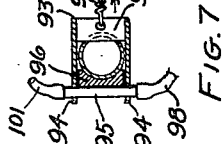
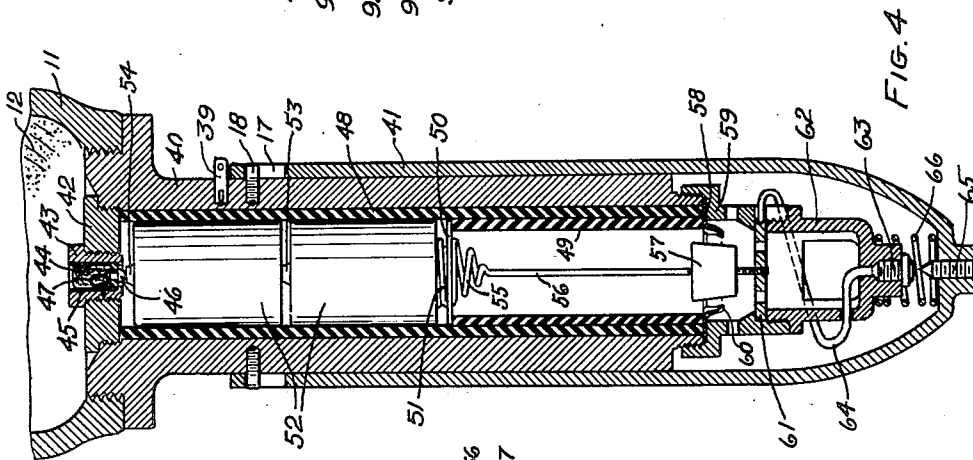
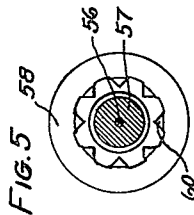
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EXPLOSIVE AND DETONATING APPARATUS

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EXPLOSIVE AND DETONATING APPARATUS

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6 Claims. (Cl. 102—70)

The present invention pertains to improvements in explosive and detonating apparatus.

One of the prime objects in modern warfare is to destroy or hamper the enemy's lines of communication and in order to do so common practice is to bomb railroad lines, highways, etc., to prevent the passage of supply and troop transports. Direct or nearly direct hits along railroad tracks by bombs which explode upon contact may be temporarily effective in rendering the railways, etc., impassable but such damage is usually detected and often repaired before the passage of a transport is attempted.

If, on the other hand, the actual explosion of the bomb is made to correspond with the arrival of the transport, wrecks and much greater destruction may be brought about, which will result in much more effective disabling of the communication line. With the types of detonating apparatus now in common use this result can be accomplished practically only by direct contact bombing of the transport itself, which practice can be carried out only on a limited scale under great hazard and difficulty.

An object of the present invention is to provide destructive apparatus including improved means to detonate the main destructive charge.

A further object is to provide means of the above nature adapted to be conditioned by initial impact for detonation by subsequent vibration or impact.

Further objects and advantages of the invention will become evident during the course of the following description in connection with the accompanying drawings in which:

Figure 1 is a vertical sectional view of a nose cap embodying one form of the invention, illustrating the device before initial impact;

Figure 2 is a similar view taken after impact;

Figure 3 is a detail view of an auxiliary firing mechanism adapted for use with the device, as shown in Figures 1 and 2;

Figure 4 is a vertical sectional view of a second form of the invention;

Figure 5 is a detail bottom view of the contact marking mechanism, Figure 4;

Figure 6 is a vertical sectional view of another form of the invention; and

Figure 7 is a detail top view of the releasing mechanism of Figure 6.

Referring to Figure 1, the numeral 10 denotes a body member adapted to be screwed or otherwise secured into the forward end of the bomb 11, the latter holding the usual explosive charge 12.

The body 10 has a central hole 13 therethrough extending through a downwardly directed boss 14. The outer wall 15 of the body 10 is cylindrical and has slidably fitted thereon a cap 16. A plurality of longitudinal slots 17 are provided in the upper end of the cap 16. Pins 18 secured in the body 10, project through the slots 17 and thus limit the possible sliding of the cap 16.

A resilient ring 19, preferably of bellows metal or the like as shown, is disposed between the lower end face of the body wall 15 and an internal shoulder 20 in the cap 16. Suitable gaskets 21 may be provided to form an air and water tight seal between the abutting surfaces of the ring 19 and wall 15 and shoulder 20. It is obvious, however, that any other suitable type of resilient seal, such as a ring of sponge rubber, can be used instead of the bellows 19.

The resilient ring 19 normally holds the cap 16 extended outward to the limit permitted by the pins 18 in the slots 17. A post 24, secured in the tip of the cap 16 and extending upwardly therein, is provided with a small rubber cap 25.

A container or bottle 26, preferably of glass, is held between the post cap 25 and a resilient washer 27 surrounding the neck of the container and pressing against the lower end of the boss 14. An envelope 28, of fine mesh material, preferably metal screen, surrounds the sides and bottom of the container 26. This envelope is maintained in central position by the boss 14 and assists in laterally supporting the container 26. The bottom of the envelope is domed upward and is pressed against the rubber cap 25 and the bottom of the container 26 and the lower portion of the envelope may be bulged outwardly to provide an annular interior space 29.

The space between the outside of the envelope 28 and the interior of the wall 15 and cap 16 contains a body 30 of granular dehydrating material such as anhydrous calcium chloride. For convenience in assembly the dehydrating charge 30, the mesh envelope 28 and a paper container 31 for the granular material may be preassembled as a unitary cartridge.

The container 26 holds a quantity 32 of chemical, for example, fulminate of mercury, adapted to detonate readily by vibration except when immersed in water, and the container also holds sufficient of the latter fluid to normally prevent detonation. The container is sealed at the top by any suitable means, such as a tight fitting stopper 33.

A safety locking pin 39 extending inward through the cap 16 into the body 10 and fric-

tionally held therein, is provided to prevent possible accidental sliding of the cap 16.

The operation of the device is as follows:

When the bomb 11 is loaded in place in an airplane the locking pin 39 is withdrawn. The bomb, of course, is provided with the usual well known means of directing the nose downward so that when the bomb is dropped the nose cap 16 first strikes the ground or other objective. The resulting impact drives the cap 16 upward relative to the body 10, breaking the container 26 as illustrated in Figure 2. The water is thereby released from the shattered container, passes through the screen 28 and is absorbed by the dehydrating charge, leaving the fulminate of mercury inside the screen, together with the pieces of the broken container. Due to its water soaked condition the fulminate of mercury is not detonated by the impact so that the bomb normally buries itself and comes to rest unexploded, after the manner of a time bomb.

The charge 30 continues to dehydrate the detonating charge 32 until within a short time the latter is sufficiently dried to be detonated thereafter by any vibration sufficient to slightly jar the mixture of fulminate and broken glass. When such vibration occurs, for example, from an approaching railway train or truck, the fulminate is detonated; the shock of the detonation is communicated through the passage 13, exploding the main bomb charge 12.

If desired, a plurality of small metal fragments 22, balls or the like, may be provided in the annular space 29 in order to augment the frictional effect of vibration on the fulminate of mercury and thus further assure detonation thereof.

Referring to Figure 3, which shows an auxiliary detonating device which may be applied to the apparatus herein described, a firing pin 23 is slidably disposed in a bushing 34 held in a casing 34^a secured to the top of the body 10. A percussion primer 35 of any suitable type is mounted in the bushing 34 above the firing pin 33 so as to be in communication with the main explosive charge. A disc 36 is secured on the lower end of the firing pin 23 and is pressed against a notched shoulder 37 by means of a substantial compression spring 38, thus normally holding the firing pin clear of the primer 35.

When the container 26 has been shattered and the charge therein dehydrated as previously described, subsequent vibration detonates the container charge in the manner set forth. The shock of this detonation drives the disc 36 and firing pin 33 upward, striking the primer 35 and thereby exploding the main bomb charge 12.

In the form of the invention shown in Figure 4, the body 40 is elongated and has a correspondingly elongated cap 41 slidable thereon, the latter being afforded limited upward movement, as previously set forth, by pins 18 in slots 17.

A bushing 42, secured in the top of the body 40, has screwed into its central portion a small hollow member 43 containing a suitable chemical charge 44 adapted to be detonated by heat. An insulating cup 45 is provided between the charge 44 and the metallic walls of the member 43. A central electrode 46 projects downward through the bottom of the insulating cup 45 and is insulated by the latter from the member 43.

A filament or heating element 47, preferably containing cerium or the like, is connected from the electrode 46 through the detonating charge

44 and the insulating cup 45 to the conducting wall of the member 43.

The elongated body 40 has a cylindrical liner 48 of insulating material. A second insulating sleeve or liner 49 is disposed in the lower portion of the main liner 48. A metallic disc 50 rests on the upper end of the inner sleeve 49 and has secured to its top surface a spring member 51. The sleeve 48 contains one or more dry cells 52 disposed below the bushing 42 and pressed upwardly by the spring member 51. These cells are arranged with their positive electrodes 53 and 54 upward. The positive electrode 53 of the lower cell presses against the negative shell of the upper battery in the manner usual to flashlight construction. The positive electrode 54 of the upper cell 52 is pressed against the detonator electrode 46.

A conical spiral spring 55 secured to the bottom of the metallic disc 50 has a straight vertical extension 56 extending downwardly through the center of the sleeve 49. A small weight 57, preferably of tapered circular form, is screwed or otherwise adjustably secured on the extension 56 near the bottom end thereof. A circular member 58 of resilient sheet metal is held against and in electrical communication with the lower end of the body 40 by means of a threaded retaining member 59.

The member 58, as shown in Figures 4 and 5, is formed with a plurality of downwardly and inwardly bent contact points 60 surrounding and normally spaced from the metallic weight 57. A disc 61 of a suitable combustible material, such as cellulose nitrate, is clamped into the retainer 59 by means of a yoke member 62. The combustible disc 61 embraces the lower end of the vertical extension 56, thus normally holding the weight 57 clear of the contact points 60.

The lower end of the yoke member 62 holds a suitable percussion primer 63 from which a fuse 64 is connected to the combustible disc 61. An upwardly directed firing pin 65 is positioned in the tip of the cap 41 below the primer 63.

A compression spring 66 normally holds the cap 41 downward so as to keep the firing pin 65 clear of the primer. A safety locking pin 39 is provided, as previously described.

In the operation of this form of the device the locking pin 39 is removed, as previously noted, when the bomb is placed in position for dropping. When the bomb is dropped nose downwardly the cap 41 strikes the objective, the impact driving the cap upwardly, causing the firing pin 65 to strike the primer 63 and thereby igniting the fuse 64. Due to the length of the fuse 64 a time interval is consumed in burning the latter which, at the end of its burning period, ignites the combustible disc 61. The disc 61 is consumed, thus releasing the end of the extension 56. Thereafter, the weight 57 is kept clear of the contact points 60 solely by the resiliently supported extension 56.

When vibration, say of a railway train or truck or the like, jars the bomb the weight 57 picks up the vibration and vibrates horizontally after the manner of a pendulum until it strikes one or more of the contact points 60.

When this contact occurs an electrical circuit is completed from the positive battery electrode 54, through the primer electrode 46, the filament 47, the member 43, the bushing 42, the body 40, the member 58, the weight 57 and the extension 56 and the spring 55, the metallic disc 50 and

spring 51 to the negative casing of the lower battery 52.

The completion of the above traced circuit causes current to flow through the filament 47, heating the latter somewhat after the manner of a flash lamp and detonating the charge 44, which in turn ignites the main charge 12 of the bomb.

Due to the conical shape of the weight 57, by preadjustment of this weight upwardly or downwardly on the extension 56 the distance between the weight and the points 60 may be varied, thus allowing the device to be set for detonation by any desired violence of vibration.

It is obvious that in manufacture the sensitivity of the circuit closing means may also be affected in any desired degree according to the size, resilience and proportion incorporated in the spring portion 55 and extension 56 as well as the mass of the weight 56. In case a bomb carrying a device of this type set for extreme sensitivity should strike its objective a glancing blow and come to rest horizontally instead of vertically, the weight 57 when released by combustion of the disc 61 may fall into contact by gravity. In such exceptional cases the device simply acts as an ordinary delayed-action bomb, exploding as soon as the fuse 64 and disc 61 have burned and thus preventing any investigation of the mechanism by the enemy. The resilience and sharpness of the points 60 provide a scraping action on the weight 57 and a certain amount of contact dwell which ensures effective completion of the circuit at all times.

In the form of the device shown in Figure 6 the nose body 67 has the main cap 68 rigidly secured thereto. A forked member 69, centrally secured in the body 67 with its forked portion 70 projecting downwardly, has slidable in its upper cylindrical portion a firing pin 71. A compression spring 72 urges the pin 71 upward toward a percussion primer 73 secured in the upper end of the member 69.

A swinging latch 74, pivoted on side pins 75 in the fork 70, has a lip 76 normally engaging a notch 77 in the firing pin 71 and thereby holding the pin 71 in cocked position as shown. A forked trigger lever 78, also pivoted on the side pins 75, is connected to the latch 74 by a toggle spring 79 which normally extends transversely slightly above the center line of pins 75 and thus holds the lip 76 firmly in the notch 77.

A tubular member 80 comprises a vertical upper portion 81 secured in the body 67, an inclined middle portion 82 clamped in the fork 70, and a vertical lower portion 83. A light cup or sleeve 84, slidable in the lower portion 83, is lightly supported therein by an adjustably mounted spring 85. A light bale 86 has inwardly directed lower ends 87 extending through longitudinal slots 88 in the lower tube portion 83 and hinged into the side walls of the cup 84. The upper end 89 of the bale 86 is pivoted in the trigger lever 78.

The inclined middle tube portion 82 is provided with transverse bottom corrugations 90 and may also be provided with a row of inwardly projecting flexible bristles 91 overlying the corrugations.

The upper tube portion 81 is slotted on its inner side to slidably receive the cross member 92 of a yoke 93. The legs 94 of the yoke 93, as shown in Figure 7, straddle the tube portion 81 and carry in holes in their ends a transverse pin 95 of readily combustible material such as cellulose nitrate. A saddle 96 is interposed between the pin 95 and the tube 81. A strong tension

spring 97 connects the bottom of the latch 74 with the yoke cross member 92. From the above description it will be evident that the spring 97 urges the cross member 92 outward from the tube 81, but withdrawal is normally resisted by the combustible pin 95 in double shear against the saddle 96. At the same time the tension of spring 97 normally assists in holding the latch lip 76 firmly in the firing pin notch 77.

One end of the combustible pin 95 is connected by a fuse 98 to a second percussion primer or cap 99 in a block 100 secured in the lower end of the central fork 70. A second length of fuse 101 connects the other end of the pin 95 with a second combustible pin 102 which spans the fork 70 immediately under the trigger lever 78 and normally prevents any downward inertia motion thereof upon impact as hereinafter noted.

A plurality of metal balls 103 are loosely disposed in the upper tube portion 81 and are normally prevented from passing to the inclined portion 82 by the yoke cross member 92 projecting into the tube.

A longitudinally slotted firing pin 104, vertically slidable in the tip of the cap 68 in line with the second percussion primer 99, is urged outward by a compression spring 105 but is retained in the cap 68 by a cross pin 106. The pin 104 is provided with a flat exterior contact head 107. A safety fork 108, is normally wedged between the head 107 and the end of the cap 68.

In operation of the example of the device as shown in Figure 6, the bomb carrying the described nose mechanism is placed in position in the bomber plane and the safety fork 108 is removed. When the bomb is dropped and strikes nose downward the firing pin head 107 strikes first, driving the pin 104 against the primer 99 which ignites the fuse 98. The latter after burning its length ignites the combustible pin 95 which is thereby destroyed. The second fuse length 101 carries the ignition to the second combustible pin 102, which latter also is ignited and destroyed.

The destruction of the pin 95 permits the spring 97 to withdraw the yoke member 92 from the tube 81, while at the same time the tension of the spring 97 is removed from the latch 74. The yoke 92 having been withdrawn, the balls 103 enter the inclined tube portion 82 where they are brought to a stop by the restraint of the corrugations 90 and the flexible bristles 91. So long as the device remains undisturbed the balls remain poised in the inclined tube, but subsequent vibration causes them to overcome the slight restraint of the bristles 91 and corrugations 90. When vibrated, therefore, the balls work down the inclined section 82 and drop one by one into the cup 84 in the vertical lower tube portion 83. When by repeated vibrations or sets of vibrations a sufficient weight of balls has collected in and above the cup 84 this weight overcomes the vertical force of the light supporting spring 85 and the toggle spring 79. As the trigger lever 78 is no longer locked by the combustible pin 102, the lever is swung downward, carrying the toggle spring 79 below the center line of pivot pins 75. The spring immediately contracts in the usual manner of spring toggle actions, snapping the latch lip 76 out of the notch 77 and releasing the firing pin 71. The compression spring 72 drives the pin 71 against the primer 73 to cause detonation therein and resultant explosion of the main bomb charge.

It will be seen that the type of device illustrated in Figure 6, instead of being actuated by

the first vibration or set of vibrations after initial impact, may be made to delay its detonation until the second, third, or even later vibratory occurrence, by the proportioning of the parts, the strength and setting of the spring 85, and the weight and number of balls employed. An example of the strategic value of this provision is in the case of attempts by the enemy to pre-explode such bombs along a railway by dispatch of a dummy or pilot train ahead of an important supply train. The delayed action described allows the pilot train to pass without hindrance, but the vibration of the following important train or trains completes the tripping action and causes explosion with consequent wreckage.

This form of the invention is best adapted to operate in the substantially vertical position normally assumed by aerial bombs in burying themselves in the ground, but a considerable inclination from the vertical is possible with only the effect of a minor variation in the number or violence of vibrations necessary to cause detonation.

The foregoing description of three typical embodiments makes clear that the invention provides bombing means having great advantage over ordinary time bombs. The latter explode at the end of a set time interval, so that their damaging effect is more or less hap-hazard, whereas with the present invention the termination of the time delay period and the consequent explosion are caused by and coincident with the arrival of the transport itself with maximum resultant damage.

A typical utilization of the invention may be to employ a comparatively large force of airplanes to drop bombs of this type at a large number of points along the railways of an enemy country at one time, the points selected being preferably as obscure and inaccessible to relief as possible and the operation being conducted with the maximum possible secrecy. The bombs having thus been "planted" and in many cases undetected over a wide area of the enemy's transportation system, and the detonating means having automatically been conditioned for operation by subsequent vibration as described, the result, instead of merely a certain amount of roadbed damage which might easily be repaired, would be a large number of destructive train wrecks at widely scattered points. The difficulty and confusion caused by such a condition are obvious, since not only would the initial destruction itself be very large but the necessity of dispatching wreck trains and the like to many points at once in order to clear and repair the lines would augment the difficulty. Furthermore, if a certain percentage of the "planted" bombs were of the type shown in Figure 6, many of the wreck and work trains themselves would be wrecked en route also. It will be seen that a properly executed use of the invention as described above could be made practically to paralyze the transportation system of a country with great effectiveness, for example, in forestalling a "blitzkrieg" expected therefrom.

Obviously a similar procedure could be carried out against highway transportation, tank advances, etc.

The invention may be applied to bomb structures of any desired size, from small light bombs to heavy land mines. It has been described primarily for use in aerial bombs, but it is evident that this type of detonating apparatus, particularly that shown in Figures 1 and 4, is also adapted for use on shells for use in howitzer and other high angle artillery fire. For such use the parts may be made heavier than in aerial bomb practice in order to withstand the initial gun blast. Also, the locking pins 39 may take the form of shear pins left in place in loading so as to prevent sliding of the cap 16 and 14 due to inertia at firing, but adapted to be sheared upon impact with the objective.

While the invention has been described in preferred form, it is not limited to the exact structures illustrated and various modifications may be made without departing from the scope of the appended claims.

What is claimed is:

1. In a detonating device for explosive apparatus, in combination, a casing, a frangible sealed vessel in said casing, a charge in said vessel normally adapted to be detonated by vibration, a fluid in said vessel inhibiting detonation of said charge, means in said casing but exterior to said vessel adapted to absorb said fluid, and means operable by impact to shatter said vessel whereby said absorbing means may absorb said inhibiting fluid from said charge.

2. The combination claimed in claim 1 including means comprising a porous wall between said charge and said absorbing means.

3. The combination claimed in claim 1 including a porous basket about said vessel, and a plurality of hard material fragments in said basket.

4. In a detonating device for explosive apparatus, in combination, a casing, a frangible sealed vessel in said casing, a charge of fulminate of mercury in said vessel, a volume of water in said vessel and enveloping said charge, a volume of dehydrating chemical in said casing but exterior to said vessel, and means operable by impact to shatter said vessel whereby said water may be released therefrom and said dehydrating chemical may dehydrate said charge.

5. In a detonating device for explosive apparatus, in combination, a casing, a sealed vessel in said casing, a charge of material in said vessel normally adapted to detonate by vibration, a second material in said vessel inhibiting detonation of said first material, means in said casing but exterior to said vessel adapted to extract said inhibiting material from said first material, and means to release said inhibiting material from said vessel to said extracting means.

6. In a detonating device for explosive apparatus, in combination, a casing, a frangible sealed vessel in said casing, a charge in said vessel normally adapted to detonate by vibration, a fluid in said vessel inhibiting detonation of said charge, means in said casing but exterior to said vessel adapted to absorb said inhibiting fluid from said charge, and means to fracture said vessel whereby said absorbing means may absorb said inhibiting fluid.

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